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Low-cost Obstacle Detector for Visually Impaired Using Ultrasonic Sensor

G.yugala Sai Lakshmi, G.Bhargavi, B.Bhargavi, J.Hema Jyothi Sri Bhadravathi

Department of Robotics,
Swarnandhra College of Engineering and Technology,
Narsapur, Andhra Pradesh, India

Abstract*: In this paper, we provide a strategy that might be helpful to persons who are visually impaired. A prototype pair of spectacles with ultrasonic sensors and a microprocessor for guiding the vision handicapped was created. The ultrasonic sensor, control module, and buzzer all make up the processing, control, and output units, respectively, of the obstacle detection module. The brain directs the ultrasonic sensors to gather data on the man's immediate surroundings, interprets that data, and then alerts him via buzzer if an impediment is detected. These Ultrasonic Smart Glasses for the Blind are a convenient, lightweight, inexpensive, and user-friendly technology for the visually impaired. Blind persons might use these glasses to simply navigate their environments and avoid hazards.*

Keywords: Glasses, visually impaired, Ultrasonic Sensors, Microcontroller

1. INTRODUCTION

Eyesight Impairment Blindness may be understood from two perspectives: the legal definition and the educational/functional definition. In order to identify which laws apply to healthcare facilities, the law uses a statutory definition. In this perspective, we focus on two aspects of vision: visual acuity and peripheral vision. The Snellen Chart is the most widely used instrument for measuring visual acuity. According to the World Health Organization (WHO), the following ranges of visual acuity constitute legal blindness as determined by the Snellen Chart. Acuity between 6/6 and 6/18 was considered normal, whereas acuity between 6/18 to >/= 3/60 was considered bad vision, and acuity below 3/60 was considered blind. Mean while, peripheral vision refers to what can't be seen when looking straight ahead. The average human eye can see objects in a 180-degree arc. The human visual system provides the most accurate description of "functional" and "educational." Humans may not make optimal use of sharp eyes despite their health benefits. an audio aid wearable device for the visually impaired that functions as an indoor navigation wearable system based on the identification of visual markers and the ultrasonic sense of barriers [1]. Blindness is a real medical condition, and there are often three distinct root causes. iMyopia, hyperopia, and astigmatism are all examples of Type I refractive diseases. Incorrect contraction and relaxation of the lens, which causes the shadow to concentrate on the retina, is a common cause of visual impairment. The problem of blind persons being unable to walk safely was addressed by developing a device that could detect obstacles and provide a warning signal proportional to the distance between the blind person and the obstruction[2]. Glasses or other optical corrections are still effective in treating this eye condition. Refractive and refractive errors of the type II variety include the cornea, the front chamber of the eye (the aqueous humor), the eye lens, and the vitreous humor and the vitreous body (the cornea and the corpus vitrea, respectively). Large enough impediments to vision form as a result of this eye condition. For instance, cataracts are quite prevalent among the elderly. Proteins in the water-and-protein eye lens suddenly clump together, making the lens opaque. Surgical treatment is available for this condition. Retinal detachments, malignant myopia, and glaucomatous muscle atrophy all fall within the category of type III illnesses, which affect the neurological system (nerves II). Optic nerve abnormalities may be life-threatening since it's possible they can't be treated. The result of this is irreversible blindness. Diseases where the retinal layers have detached from the central nervous system's attachment site are still treatable. Surgical treatment is available for this condition. However, at the same risk of permanent blindness, any recurrence of eye disturbance will worsen the eye. Localization and navigation are two of the most important jobs for a mobile robot, and they may both be accomplished with the help of a camera from Microsoft called Kinect[3]. A concept for a short, portable electronic cane that makes use of Polaroid's Ultrasonic Ranging Unit and is designed to enhance or replace the conventional long cane is presented[4]. An intelligent assist blind glass system that includes a wireless transmission module, a high-definition camera, an infrared sensor, and an eyeglass frame that mounts the cartridge[5].The following example of an embodiment of the present invention is a method for providing navigation information about a physical environment to a user[6]. This particular example relates to the present invention. There was a contribution from an innovation. An electronic talking stick for the blind, and more specifically, to a stick that speaks to guide a blind man how to walk[7].

This paper aims to create eyewear models that may be used to help the visually impaired choose which way to go or what route to take. The specific goals of this study are as follows. Optimal spectacles for the visually impaired, built from the model up. The glasses-blind design incorporates the wall-follower idea. Evaluating the effectiveness of custom-made blind spectacles.

Materials used

The following are some of the stages involved in R&D: One must first do a needs analysis before moving on to the next steps, which are as follows: 1) Preparation; 2) Hardware Development; 3) Software Development; 4) Testing. The resultant glasses include an ultrasonic sensor that both produces and catches infrared light, allowing them to detect the presence of an item. Then, the reflected light was stopped, the reflect time was calculated, and the distance was obtained; this information was then sent to the vibrator module. The vibrational frequency is used to derive distance information. The vibrational frequency is 50 hertz over a range of 0-1 meters, following are the materials used. Arduino nano, Ultrasonic sensor, Spectacles, Buzzer, Jumper wires, Battery, Electronic Switch

2.1Material Specifications:

Power Supply: 3.3V – 5V.

Operating Current: 8mA.

Working Frequency: 40Hz.

Ranging Distance : 3cm – 350cm/3.5m.

Resolution : 1 cm.

Measuring Angle: 15 degrees.

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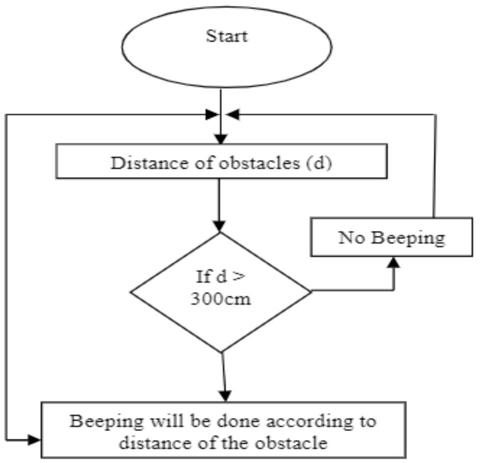
Trigger Input Pulse width: 10uS TTL.



2.3Raspberry Pi and PICO

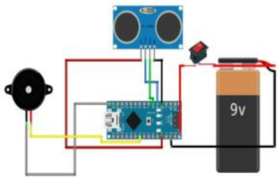
The Raspberry Pi 4 has a 40-pin GPIO header, a 4GB memory, a quad-core 64-bit CPU, WiFi networking, a dual-display output, and the ability to play 4K video. The Raspberry Pi 3 Model B+ is the most capable and user-friendly computer of its kind. To make it easily transportable, Raspberry pi is utilized. We are unable to use our own system on the go. That's why we used a Raspberry Pi to store everything. BalenaEtcher is a tool for flashing operating system images on SD cards over USB. Once the SD card has been flashed, it can be used in a raspberry pi. We need to get all the necessary libraries set up. Then link the power supply to the portable battery. You can even connect your camera and speaker over Bluetooth! Before disconnecting the screen, keyboard, and mouse, make sure everything is working as intended. Take down the screen, etc., after the program is up and running. In order to facilitate portability.

2.4 Sensors

Sensors are devices that only monitor input signals from their physical surrounds or environment and react properly to the input signal and condition. Heat, light, motion, pressure, or any other environmental phenomenon might be used as input signals. The output of a sensor is often a signal that is further processed by electronic transmission across a network, or it is turned into a human-readable display signal at the sensor site [8]. A sensor often emits particular types of energy, such as ultrasonic waves or laser beams, and determines whether an item in the direction of transmission is interfering with the energy flow [9].

2.5Model setup

A pair of glasses, a central obstacle detection module, a processing unit, and a power source all contribute to this apparatus. A processing unit is connected to an output device and an obstacle detection module. The CPU is powered by the system's electrical source. The ultrasonic sensor, the control module, and the buzzer all work together to form the obstacle detection, processing, and audible alerting system. Ultrasonic sensors are activated by the control unit as shown in figure 1, which then collects data about the barrier or item in front of the person, processes it, and delivers the results through a serial connection. When an impediment is nearby, the user is informed through voice prompt, and when money is there, the system can recognize it automatically thanks to AI. Parallax manufactures the ultrasonic range finder (PING Sensor). The PING sensor was developed for the sole purpose of determining the relative distance between two solid objects. This sensor can detect distances from 3 centimetres to 500 centimetres without touching the object being measured[10]. Using ultrasonic waves (50 kHz) and a short period of transmission time, the PING sensor can determine the distance to an item. The microprocessor sends out trigger pulses that cause the PING sensor to release ultrasonic waves. The PING sensor's timing diagram is seen in Figure 2.



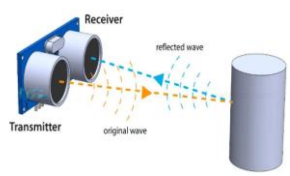


Figure 1. Circuit diagram Figure 2. Sensor timing diagram

3.Development stage

The development process was carried out using a blindfold for both the hardware and software stages. Formulation implementation docs for each module's implementation are created as the first stage of development. There are a number of steps involved in this procedure, such as basing the construction on the chasing design created in the preceding procedure and selecting the appropriate chasing glasses to serve as the procedure's foundational material. Software development is a stage in the process of programming the electronic equipment that will be put in glasses, such as the microcontroller, so that the blind person may be guided while jogging to his desired destination[11]. The programming effort also tries to unify the many components of the glasses' design, such as the sensors, compass, and pointer shaking that serve as output. Prototyping culminates in the Assembly phase, when the ergonomically designe

3.1Python code:

```
#define pingPin 2 //trig pin of sr04
#define echoPin 3
void setup() {
        Serial.begin(9600); // Starting Serial Terminal
        pinMode(pingPin,OUTPUT);
        pinMode(echoPin,INPUT);
        pinMode(12,OUTPUT);
        //pin12 is used as GND pin for buzzer since arduino nano has only two GND pins
        pinMode(A3,OUTPUT); //pin A3 provides the output on buzzer
}
void loop() {
long duration, cm;
digitalWrite(12, LOW); //Buzzer GND is always low
//send a signal at ping pin at an interval of 0.002 seconds to check for an object
        Digital Write (pingPin, LOW);
        delay Microseconds(2);
        digital Write (pingPin, HIGH);
        delay Microseconds(10);
        digital Write (pingPin, LOW);
        duration = pulseIn (echoPin, HIGH); //check time using pulseIn function
cm = microseconds To Centimeters (duration); //functin call to find distance
/* Serial.print(cm);
Serial.print("cm");
Serial.println();
delay(100);
for debugging
*/
if (cm<30&&cm>20)
{ analog Write(A3,255);
delay(1000);
analog Write(A3,0);
delay(1000); } //sound buzzer every second if obstacle distance is between 20-30cm.
```

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```
else if (cm<20&&cm>10) {analog Write(A3,255);
delay(500);
analog Write(A3,0);
delay(500); } //sound buzzer every 0.5 seconds if obstacle distance is between 10-20cm.
else if (cm<10&&cm>0) {analog Write(A3,255);
delay(100);
analog Write(A3,0);
delay(100); } //sound buzzer every 0.1 seconds if obstacle distance is between 0-10cm.
else analog Write(A3,0); //do not sound the buzzer
}
//function to return distance in cm from microseconds
long microseconds To Centimeters (long microseconds) {
return microseconds / 29 / 2;
```

4.Working

The complete front and side view of the obstacle detector are shown in figure 3. A system that is inexpensive and makes use of input and output sensors that are linked via an Arduino board. After the environment immediately in front of the subject has been detected by the sensors, the signal will be transmitted to the processor. The processor reacts to the input and then transmits the signal that corresponds with it to the output transducer. The user will be informed in the appropriate manner by the buzzer sound or the beep sound that comes from the output transducer.

Figure 3. Obstacle detector front view

4.1Trial test

Tests were run using the object detection module's ability to see real-world objects. For each individual module, the exam is comprised of a subset of questions. The effectiveness of full glasses has been tested extensively. Each test step provides valuable feedback to the development team as they assess the system and its modules. The following phase, when the prototype is finished, is to put it through testing to see whether it works as intended and matches the design. To observe first hand whether or not the visually impaired's reactions to this prototype are adequate, we're using a direct-blind testing method. The Fabrication of obstacle detector for blind people is designed to help the blind overcome the lack of visual sense by using other senses like sound. It uses sound to notify the user about upcoming obstacles. By wearing this device, they can fully avoid the use of sticks and other such devices. These devices will assist the blind in navigating without the use of a stick, which is inconvenient for them. They can simply wear it and it can function very accurately.

Conclusion

The finished product of this study is a tool that directs the blind control technology, which is a microcontroller with a sensor as its input source. The following are some of the findings that may be taken from this study's data set. The ultrasonic sensor provides useful information for the visually impaired. A microcontroller is an efficient piece of data processing equipment for determining an object's existence. Using a proximity sensor built into specially designed glasses, the device assists the visually impaired to locate items in their immediate surroundings. The user (the blind person) must practice and adjust to the guide device, which is a proximity sensor built into a pair of spectacles. The system directs the ensuing demand for more development, such as a camera to tell the item kind.

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